

## **SECTION 16111 CONDUIT AND FITTINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawing and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
1. Rigid metal conduit and fittings.
  2. Intermediate metal conduit and fittings.
  3. Electrical metallic tubing and fittings.
  4. Flexible metal conduit and fittings.
  5. Liquid tight flexible metal conduit and fittings.
  6. Schedule 40 PVC, rigid non-metallic conduit and fittings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 7, Thermal and Moisture Protection: Fire Zone Penetrations.
  2. Section 16118, Underground Conduit Duct Bank.
  3. Section 16131, Boxes.
  4. Section 16191, Supporting Devices.
  5. Section 16196, Electrical Identification.

#### **1.3 REFERENCES**

- A. American National Standards Institute (ANSI):
1. ANSI C80.1-90, Rigid Steel Conduit, Zinc Coated.
  2. ANSI C80.3-91, Electrical Metallic Tubing, Zinc Coated.
  3. ANSI C80.5-90, Rigid Aluminum Conduit.
  4. ANSI C80.6-86, Intermediate Metal Conduit.
- B. National Electrical Manufacturers Association (NEMA) :
1. NEMA FB 1-93, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  2. NEMA RN 1-89, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  3. NEMA TC2-90, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
  4. NEMA TC3-90, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- C. National Fire Protection Association (NFPA):
1. NFPA 70-1999, National Electrical Code.
  2. NFPA 321-1991, Standard on Basic Classification of Flammable and Combustible Liquids.
- D. Underwriters Laboratories, Inc. (UL)
1. UL 1-85, UL Standard for Safety – Flexible Metal Conduit.
  2. UL 6-81, UL Standard for Safety – Rigid Metal Conduit.
  3. UL 360-86, UL Standard for Safety – Liquid tight Flexible Steel Conduit.
  4. UL 651-89, UL Standard for Safety – Schedule 40 and 80 Rigid PVC Conduit.
  5. UL 797-83, UL Standard for Safety – Electrical Metallic Tubing.
  6. UL 1242-83, UL Standard for Safety – Intermediate Metal Conduit.

- E. Institute of Electrical and Electronics Engineers (IEEE):
  - 1. IEEE 384 – Standard Criteria for Impedance of Class 1E Equipment and Circuits.
- F. American Standards for Testing and Materials (ASTM):
  - 1. ASTM E84-91a, 1997, Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and General and Supplementary Conditions.
- B. All products require submittal.
- C. Submit proposed substitutions for approval in accordance with General and Supplementary Conditions.
- D. Submit for information as-built drawings indicating accurate routing of conduits 2 in. and larger.

#### 1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Equipment and components shall be designed, fabricated, and installed in compliance with NFPA 70A.
- B. UL and NEMA Compliance: Provide components required as part of conduit systems that are listed and labeled by UL and comply with applicable NEMA standards.
- C. Coordination: Coordinate layout and installation of conduit systems with piping and ductwork and with other installations.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver conduit to job site in 10-ft lengths. Inspect for damage.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering in a manner to ensure installation of materials in new condition.
- C. Protect PVC-coated conduit and PVC conduit from sunlight.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Coordinate location of conduit systems with other construction activities.

### PART 2 - PRODUCTS

#### 2.1 RIGID METAL CONDUIT AND FITTINGS

- A. Heavy-Wall Rigid Galvanized Steel Conduit: ANSI C80.1; UL 6 listed; Schedule 40 hot dipped galvanized or electrogalvanized conduit.
- B. Rigid Aluminum Conduit: ANSI C80.5; UL 6 listed; Schedule 40.

- C. PVC Coated Conduit: NEMA RN 1; UL listed; Schedule 40 rigid steel galvanized conduit with bonded exterior PVC coating a minimum of 0.035 in. thick; urethane coating over galvanized interior and threaded ends; Robroy Industries "Plastic/Bond Red."
- D. Fittings and Conduit Bodies: NEMA FB 1; threaded type, arterial to match conduit; Appleton, Crouse-Hinds, or Killark.
- E. Bushing: Nonmetallic, insulating-type; O-Z/Gedney Type A, Thomas & Betts Series 200, or Appleton Type BBU.

## 2.2 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. IMC: ANSI C80.6; UL 1242 listed; hot-dipped galvanized steel, intermediate weight, rigid-type electrical conduit.
- B. Fittings and Conduit Bodies: NEMA FB 1: threaded type, material to match conduit; Appleton, Crouse-Hinds, or Killark.
- C. Bushings: Nonmetallic, insulating-type; O-Z/Gedney Type A, Thomas & Betts Series 200, or Appleton Type BBU.

## 2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. EMT: ANSI C80.3; UL 797 listed; zinc-coated, enamel-lined, thread less, thin-wall steel tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel compression type. Set screw and indenter type fittings are not acceptable.

## 2.4 FLEXIBLE METAL CONDUIT FITTINGS

- A. Flexible Metal Conduit: UL 1 listed: hot-dipped galvanized or electrogalvanized, inside and outside; made in one continuous length of spirally-wound steel strip with uniform interlocking convolution.
- B. Fittings and Conduit Bodies: NEMA FB 1.

## 2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Liquid tight Flexible Metal Conduit: UL 360 listed; galvanized steel flexible tubing with synthetic jacket extruded over tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1.
- C. Liquid tight Conduit Assemblies: Thomas & Betts Company Series 5300; insulated, straight, or 90-degree angle connector on each end.

## 2.6 PLASTIC CONDUIT AND FITTINGS

- A. Rigid PVC Conduit: NEMA TC2, UL 651 Listed, Schedule 40 and 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC3

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify field measurements.
- B. Verify conduit routing and termination locations, sleeve sizes, and locations prior to rough-in.

### 3.2 INSTALLATION

- A. General
  1. Route conduit in approximate locations unless dimensioned.
  2. Cut conduit square with approved conduit cutter and thread with approved conduit threader. Ream ends of burrs, and remove metal shavings and cutting lubricants before conduit is connected to conduit system.
  3. Coat field-cut thread in IMC and rigid steel conduit with Thomas & Betts "KOPR-SHIELD."
  4. Coat aluminum conduit threaded connections with Thomas & Betts "ALUMA-SHIELD."
  5. Make conduit connections with appropriate fittings and tighten securely.
  6. Close conduit openings into which dirt, plaster, mortar mix, or debris may fall with caps or tight-fitting plugs during construction. Clean conduits in which such material has accumulated. Replace the conduit where such accumulations cannot be removed.
  7. Seal conduits for the purpose of preventing airflow and rodent and insect access with a pliable, duct-sealing compound such as John-Manville "Duxseal."
  8. Use appropriate tools to install PVC-coated conduit; avoid damage to exterior coating. After installation, repair damaged area with plasti-Bond touch-up compound.
  9. Coat aluminum conduit with asphaltum paint when penetrating concrete or masonry walls and floors.
  10. Install flexible metal conduit that is liquid tight where exposed to weather, water, or other liquids.
  11. Seal all conduit ceiling/wall/floor penetrations, except when directly entering a panel.
  12. Minimum conduit size: 3/4 inch trade size.
  13. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- B. Aboveground (Exposed or Concealed)
  1. Install exposed conduits at right angles to or parallel to building structural members.
  2. Do not secure conduit directly to other piping. Separate conduit parallel to or crossing uninsulated hot water or steam pipes by 12 in. if parallel or 6 in. if crossing. Where these lines are insulated, conduit parallel to or crossing them must clear insulation surface by 2 in. Separate conduit from cold water lines by at least 3 in. Do not run conduit directly under cold water lines.
  3. Support IMC, rigid metal conduit, and EMT, whether concealed or exposed, in accordance with paras. 345-12, 346-12, 347-8, and 348-12 of the NEC, respectively.
  4. Secure metallic conduit to walls and building framing using malleable iron, galvanized U-bolts, beam clamps, conduit straps, or "Unistrut" fittings where "Unistrut" racks or supports are used.
  5. Fasten IMC and rigid metal conduit to outlet boxes, pull boxes, cabinets, and switch boxes with double lock nuts and insulating bushings unless boxes with hubs are furnished.
  6. Terminate EMT with rain tight, compression-type connectors with insulated throats. Use couplings for EMT that are rain tight, compression type. Set screw-type connectors and couplings are not acceptable.
  7. Install expansion couplings in conduit runs crossing building expansion joints; locate between conduit supports adjacent to expansion joint.

8. Use liquid tight conduit assemblies between motor terminal boxes or other equipment subject to vibrating or mechanical adjustment, and rigid conduit systems.
  9. Size liquid tight conduit length terminating in motor terminal boxes not less than 12 times the trade size but not less than 12 in.
  10. All aboveground conduits installed in the CHL building shall be rigid metal conduit or intermediate metal conduit.
  11. All exposed conduit installed within 10 feet of finished floor shall be rigid steel or intermediate metal conduit.
- C. Under Slab on Grade
1. Install conduit in or under floor slab as dimensioned.
  2. Use PVC Schedule 40 or rigid galvanized steel conduit in or under building floor slabs for straight sections and long radius bends.
  3. Coat threaded connections in conduits installed in building floor slabs with Thomas & Betts "KOPR-SHIELD" sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured. Cap unused conduits, utilizing watertight caps in conduits subject to being filled with water.
  4. All penetrations through concrete slabs shall be rigid galvanized steel.
- D. Underground (Across site and below parking lots individual runs)
1. Install conduit underground as dimensioned.
  2. Mark location of underground conduit above ground with pins or concrete markers.
  3. Use PVC Schedule 40 or rigid galvanized steel conduit in underground installations for straight sections and long radius bends.
  4. Encase underground conduits, where noted, in concrete; conform to requirements of Section 16118.
  5. Coat threaded connections in conduits installed underground with Thomas & Betts "KOPR-SHIELD" sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured. Cap unused conduits, utilizing watertight caps in conduits subject to being filled with water.
  6. All underground 90° elbows and penetrations through concrete slabs and in pole bases shall be rigid galvanized steel.
- E. Telecommunications System Conduit
1. Provide a No. 14 soft iron pull wire between pull boxes where length of conduit run is less than 100 ft. For runs of 100 ft. and longer, install a No. 10 soft iron pull wire.
- F. Specific Conduit Installation and Marking Requirements:
1. Install conduit for the TPS in accordance with IEEE-384.
  2. Target Protection Systems (TPS) conduit shall be permanently marked at intervals not to exceed 15 feet and at points of entry and exit from enclosed areas. The TPS has two channels. Channel 1 conduit will be marked in blue with a marker labeled "TPS1." Channel 2 conduit will be marked in gray with a marker labeled "TPS2."
  3. The TPS conduit shall not be routed through fire hazard areas as defined for liquids in NFPA-321, solids with a flame spreading classification of 26 or higher in accordance with ASTM E84-91a, or coatings with flame spread classification of 50 or higher in accordance with ASTM E84-91a.
  4. Conduit fire stops through fire barriers shall have fire-resistance rating commensurate with the fire hazard being protected against.
  5. At least 1 inch vertical and 1 inch horizontal shall separate TPS cable where both channels are in enclosed conduit inside non-hazardous areas. Channel separation from open to open tray is 1 inch horizontal and 8 inch vertical. Channel separation from enclosed to open is 1 inch horizontal and 3 inch vertical.
  6. Contract Manager will provide QA staff to document the installation of the TPS conduit and cabling.

### 3.3 FIELD QUALITY CONTROL

- A. Verify that installed conduit systems are clean and ready to accept wiring.

### 3.4 CLEANING

- A. Clean conduits of all debris and leave in condition for pulling cable.

### 3.5 PROTECTION

- A. Provide protective caps and lugs for all conduit systems that will not have wiring installed.
- B. Provide protective caps and plugs for all conduits where it is likely that foreign materials may enter conduits prior to completion of the wiring system.

**END OF SECTION 16111**